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### (54) Tip resistant bottle filter

(57) A filter assembly includes an angled vacuum port for providing improved stability when the filter assembly is attached to a receptacle. The vacuum port is disposed at an acute angle with respect to a longitudinal axis extending through the funnel of the filter assembly. The acute angle includes an x, or horizontal component, as well as a y, or vertical component. The downward angling of the vacuum port increases the stability and thereby decreases the incident of tipping of the receptacle and filtration assembly.

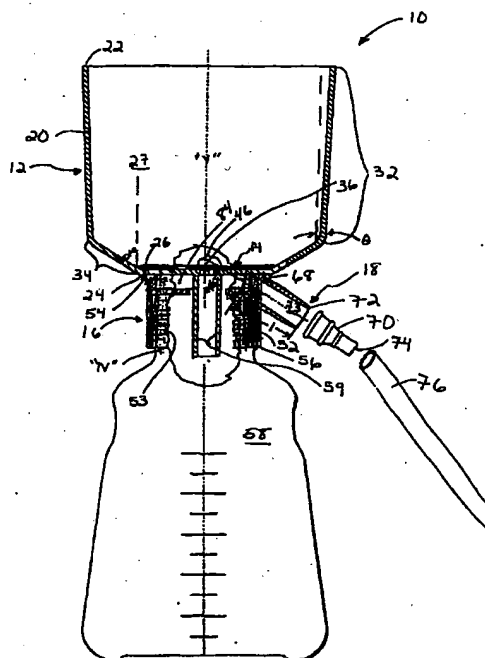


Fig. 1

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## Description

### TECHNICAL FIELD

The present application relates to a tip resistant bottle filter.

### BACKGROUND OF RELATED ART

Bottle filters and bottle filter systems are frequently utilized in laboratory settings to filter, purify, clarify or sterilize tissue culture media, serum, antibodies and other laboratory compounds. As the name implies, bottle filters are adapted to be mounted to the neck of a bottle. In use, a technician first attaches the bottle filter assembly to the neck of a receiver bottle and then connects a vacuum hose to a vacuum port which extends laterally from the adapter neck of the bottle filter assembly. The technician then pours the fluid to be filtered into the tunnel of the bottle filter assembly, being careful not to tip the bottle over as he/she pours. Once the fluid has been transferred to the tunnel, the technician turns on the vacuum connected to the filter assembly and waits for the filtered fluid to drain into the bottle. The receiver bottle may be an existing laboratory bottle, or alternatively, may be a plastic bottle supplied with the bottle filter.

A common problem associated with the use of a conventional bottle filter assembly, illustrated in Fig. 4, is that once the vacuum line is connected to the transverse vacuum port, the empty bottle tends to become top-heavy and, therefore, likely to tip over as, or after, the funnel is filled with fluid. The weight of the attached vacuum hose and the residual tension, or "springiness", in the hose contribute to the unstable condition of the bottle and filter assembly. This is especially true with the increase in use of plastic bottles which are very light weight and, therefore, do not offer the stability of a heavy glass bottle.

In order to reduce the likelihood of tipping, technicians must often support the empty bottle with one hand during the filling operation. This, however, is awkward for the technician, and can result in the technician spilling fluid as he/she tries to introduce the fluid into the funnel with one hand. This is especially true when the filter is attached to a centrifuge tube which has an elongated configuration, thereby increasing the likelihood of tipping. To help alleviate this problem, several manufacturers have developed "compact" bottles which are shorter and include a larger diameter bottom than conventional bottles, for increased stability.

There is therefore needed an improved bottle filter assembly which is tip-resistant and which can be utilized with a variety of bottle shapes and sizes.

### SUMMARY OF THE INVENTION

In accordance with the invention there is provided a

filter assembly including a funnel into which fluid to be filtered is introduced, the funnel having a longitudinally extending axis, a filter membrane supported by the filter assembly, an adapter supported by the funnel, and a vacuum port extending from the adapter at an acute angle with respect to the longitudinal axis. The angled port is provided to apply a vacuum in order to influence the flow of liquid through the filter by reducing the air pressure, or creating a vacuum, in the bottle with the angle of the port being sufficient to enhance stability of the filter assembly when the funnel is partially filled with liquid and attached to a receptacle. The angled port reduces the force applied by the vacuum hose to the bottle, thereby reducing the probability of the filter assembly and/or bottle tipping.

According to the present invention, the vacuum port is disposed at an acute angle with respect to longitudinal axis Y, and therefore includes both an x, or horizontal component, as well as a y, or vertical component. The downward angling of the vacuum port increases the stability and thereby decreases the incident of tipping of the receiving bottle or container, and the filtration assembly. This is particularly true prior to filtration, when the receiving bottle is empty and the funnel is filled with fluid (a top heavy condition). Angle preferably ranges from 30 to 60, and more preferably is approximately 45. Alternately, angle may be any acute angle, the criteria for the angle of the vacuum port being that the angle is not so great as to interfere with operation of the filter assembly, i.e. by causing tubing attached to the port to hit the side of the receiving bottle, nor should the angle be so slight as to be ineffective, i.e. does not impart increased stability to the bottle and filter assembly.

### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a side view, in partial cross-section of a preferred embodiment of a filter assembly with an angled vacuum port, attached to a receiving bottle, according to the present invention;

Fig. 2a is a detail view of an alternate embodiment of the angled vacuum port of Fig. 1;

Fig. 2b is a detail view of an alternate embodiment of the angled vacuum port of Fig. 2a;

Fig. 3 is a top view of the filter assembly of Fig. 1; and

Fig. 4 is an exploded view of a prior art filter assembly with a transverse vacuum port.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring initially to Fig. 1, bottle filter assembly 10 includes a funnel 12, a filter 14, an adapter 16 and a vacuum port 18. In the present embodiment the aforementioned parts are separately fabricated and permanently secured together but may, alternately, be integrally formed.

Funnel 12 preferably includes a generally cylindrical side wall 20 which is disposed about a longitudinally extending, vertical axis, "Y", and a generally horizontal, or flat, bottom wall 26. Side wall 20 is open at a first end 22, in order to receive a fluid to be filtered, and is capped at a second end 24, opposite the first end, by bottom wall 26. Side and bottom walls 20 and 26, respectively, define an upper chamber, or reservoir 27, which receives the fluid to be filtered. Side wall 20 is preferably fabricated from a clear, plastic material in order to readily view the fluid as it is being poured and filtered. A lip 28 is preferably molded about first end 22 for receiving a corresponding coverall lid (not shown). The lid, when positioned over the first end of wall 20, allows air to enter the funnel under the lid while preventing debris from falling into the funnel.

In the present embodiment, side wall 20 has an upper section 32 which is slightly tapered at an angle from vertical, approximately  $1\frac{1}{2}$ , and a lower section 34 which is more sharply inclined at an angle from the vertical, approximately 60 in the present embodiment. Alternately, side wall 20 may be tapered at any number of angles, or may not be tapered at all. In the present embodiment, due to its tapered configuration, side wall 20 has a decreasing diameter in a downward direction, until it reaches the generally flat bottom wall 26.

Bottom wall 26 supports filter membrane 14, for example by use of a filter grid support, as is known in the art. Preferably bottom wall 26 is integrally molded with side wall 20 and includes a central portion 46 having an opening 36 disposed therethrough. The tapered configuration of side wall 20 helps direct the fluid to be filtered toward opening 36, once the fluid has passed through filter 14.

Filter membrane 14 may be any of a variety of commercially available membranes, the type of filter chosen being a function of the fluid to be filtered. The filter may typically be either an ultralow binding cellulose acetate membrane or a low binding sterilizing grade polyether-sulfone membrane. Many other filter materials may also be used, such as nylon, urethane, polypropylene and fiberglass. The pore sizes may typically vary from approximately .2 to .45 microns.

Integrally molded or bonded to the bottom wall 26 is neck adapter 16. Adapter 16 is generally cylindrical in shape and is preferably concentric about axis "Y". In the present embodiment adapter 16 includes a wall 52 having an upper end 54 which is partially open to and molded or bonded to the bottom wall 26, and a lower end 56 which is open to, preferably concentric with, and adapted to fit around a neck "N" of bottle 58. Adapter 16 preferably includes a stem member 59 disposed therein, the stem member extending from opening 36 of wall 26, such that any fluid which flows from the upper chamber 27 through filter 14 and opening 36 will enter and flow through the stem member, without flowing into the plenum chamber and into the vacuum line, as is known in the art.

In the present embodiment cylindrical wall 52 preferably includes an internally threaded collar 53 which is sized to screw onto the neck of a standard size media bottle 58. Alternately, other conventional means may be utilized to attach filter assembly 10 to bottle 58, such as a snap-fit assembly. A sealing gasket is also utilized to form a seal between the adapter and bottle. The seal enables a vacuum to be applied through vacuum port 18, to the interior of the adapter, so as to maintain a negative pressure in the bottle and then draw media or other fluid from the funnel 12, through the filter membrane 14 and adapter 16 and into the bottle 58, or other container or receptacle on which the filter assembly is mounted.

With continued reference to Fig. 1, vacuum port 18 is preferably integrally formed at a first end 68 thereof with adapter 16, and is adapted to matingly receive a corresponding nipple, or universal vacuum connector 70 at a second end 72, opposite the first end thereof. Vacuum port 18 is preferably constructed of a generally rigid or semi rigid plastic, such as a styrene, or polyolefin-type resin, includes a bore 73 extending along its length, "1", which communicates with a central opening 74 of vacuum connector 70. Vacuum connector 70 is, in turn, designed to be connected to tubing 76 which is connected to a vacuum pump or central vacuum supply (neither shown) when the device is in use.

Unlike conventional filter assemblies, such as the prior art device shown in Fig. 4, vacuum port 18 extends from adapter 16 at an angle with respect to axis "Y" (Fig. 1). By angling port 18, both a vertical and horizontal directional component are imparted by port 18 on bottle filter assembly 10. Conventional devices (Fig. 4) extend laterally, or 90 from vertical, and therefore only impart a horizontal component to conventional bottle filter assemblies. Thus, in conventional devices when the funnel is filled with fluid and the receiving bottle is substantially empty, the bottle and filter assembly become particularly unstable due to the weight and/or residual tension of the tubing, thereby increasing the likelihood that the bottle and filter assembly will tip over. This is especially true when lightweight, plastic bottles, are employed. As filtration proceeds, the receiver bottle fills with filtrated liquid, thereby increasing the overall stability of the bottle and filter assembly.

According to the present invention, port 18 is disposed at an angle, with respect to vertical axis Y, and therefore includes both an x, or horizontal component, as well as a y, or vertical component. The downward angling of port 18 increases the stability and thereby decreases the incident of tipping of bottle 58 and filter assembly 10. This is particularly true prior to filtration, when bottle 58 is empty and funnel 12 is filled with fluid. Angle is preferably in the range of approximately 30 to approximately 60, and is approximately 45 in the present embodiment. Angle may be any acute angle, the criteria for the angle of port 18 being that the angle is not so great as to interfere with operation of the filter

assembly, i.e. the angle should preferably be great enough to clear both the hand of the technician and the bottle, nor should the angle be so slight as to be ineffective, i.e. does not impart increased stability to the bottle and filter assembly.

Alternately, as shown in Fig. 2a, a port assembly 118 may be utilized in place of angled port 18. Port assembly 118 includes a conduit 81 which extends substantially horizontal from adapter 16, and an angled adapter 80 in fluid communication with conduit 81. Angled adapter 80 may replace vacuum connector 70, or alternately, may be adapted to receive vacuum connector 70 at one end thereof. Adapter 80 is preferably a right-angle adapter, but alternatively may be any angled configuration, as shown in Fig. 2b, as long as the angle does not interfere with operation of the filter assembly, i.e. by hitting the bottle or hand of the technician, and provided that the angled adapter increases the stability of the bottle and filter assembly, as described above. Adapter 80 is preferably rotatable about port 118, such that tubing 76 can be selectively positioned with respect to bottle 58 and filter assembly 10, as shown in Fig. 2a.

In operation, a technician screws adapter 16 onto the neck, N, of bottle 58, which may be any type of container, with varying dimensions. The technician then attaches tubing 76 to vacuum connector 70 disposed about angled vacuum port 18. Alternately, the technician can attach the tubing to angled adapter 80 connected to transverse port 118. In either case, the bottle and filter assembly is provided with an increased stability as the technician pours the fluid to be filtered into the funnel 12. After the fluid is introduced into funnel 12 the vacuum pump is turned on. When the vacuum is applied through tubing 76, a low pressure region is established in the bottle (through the adaptor 16), particularly in chamber 84, below the bottom wall 26 of the funnel 12 and beneath filter membrane 14. Because the neck, "N", of the bottle 58 is sealed to the adapter by a gasket or seal surface (not shown), the vacuum may be applied beneath the filter membrane 14 in the adapter 16 without difficulty. The low pressure created in the bottle influences the flow of the fluid to be filtered through filter membrane 14, to the opening 36 and down the stem member into the bottle 58, or container, onto which the filter assembly is mounted. At the completion of filtration, filter assembly 10 is removed from bottle 58 and is preferably discarded.

It will be understood that various modifications may be made to the embodiment disclosed herein. For example, although the vacuum port is illustrated with one type of filter assembly, the port may be utilized with a variety of filter assemblies, including filter assemblies utilized with centrifugal tubes or any kind of bottle top filter or filter capsule that uses a vacuum port. In addition, the receiving bottle may be any number of shapes and sizes, and may be any type of container utilized with the filter assembly. Therefore, the above description should not be construed as limiting, but merely as exemplifica-

tions of a preferred embodiment. Those skilled in the art will envision other modifications within the scope spirit of the invention.

## 5 Claims

1. A filter assembly adapted for use with a receptacle comprising:

10 a funnel having an open end through which fluid to be filtered is introduced, at least one side wall which retains the fluid to be filtered and an opening through which a filtered fluid passes, the funnel having a longitudinal axis extending therethrough;  
 15 a filter membrane supported by the filter assembly relative to the opening;  
 an adapter supported by the funnel; and  
 a vacuum port for applying a vacuum to influence the flow of liquid through the filter membrane, the vacuum port extending from the adapter at an angle with respect to the longitudinal axis sufficient to enhance the stability of at least one of the filter assembly or receptacle when a vacuum tube is attached thereto.

2. The filter assembly according to Claim 1, wherein the angle is in the range of approximately 30 to approximately 60 degrees.
3. The filter assembly according to Claim 2, wherein the angle is approximately 45 degrees.
4. The filter assembly according to Claim 1, wherein the vacuum port comprises a conduit and an angled adapter.
5. The filter assembly according to Claim 4, wherein the angled adapter is a right angle adapter.
6. The filter assembly according to Claim 1, further comprising a vacuum connector disposed at least partially about the vacuum port.
7. The filter assembly according to Claim 6, further comprising flexible tubing connected to the vacuum connector at one end thereof.
8. The filter assembly according to Claim 4, further comprising a vacuum connector disposed at least partially about the angled adapter.
9. The filter assembly according to Claim 8, further comprising flexible tubing connected to the vacuum connector at one end thereof.
10. The filter assembly according to Claim 1, wherein the funnel further includes a bottom wall supporting

the filter membrane.

11. The filter assembly according to Claim 1, wherein the assembly is mounted to a receptacle.

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12. The filter assembly according to Claim 11, wherein the receptacle is a compact bottle.

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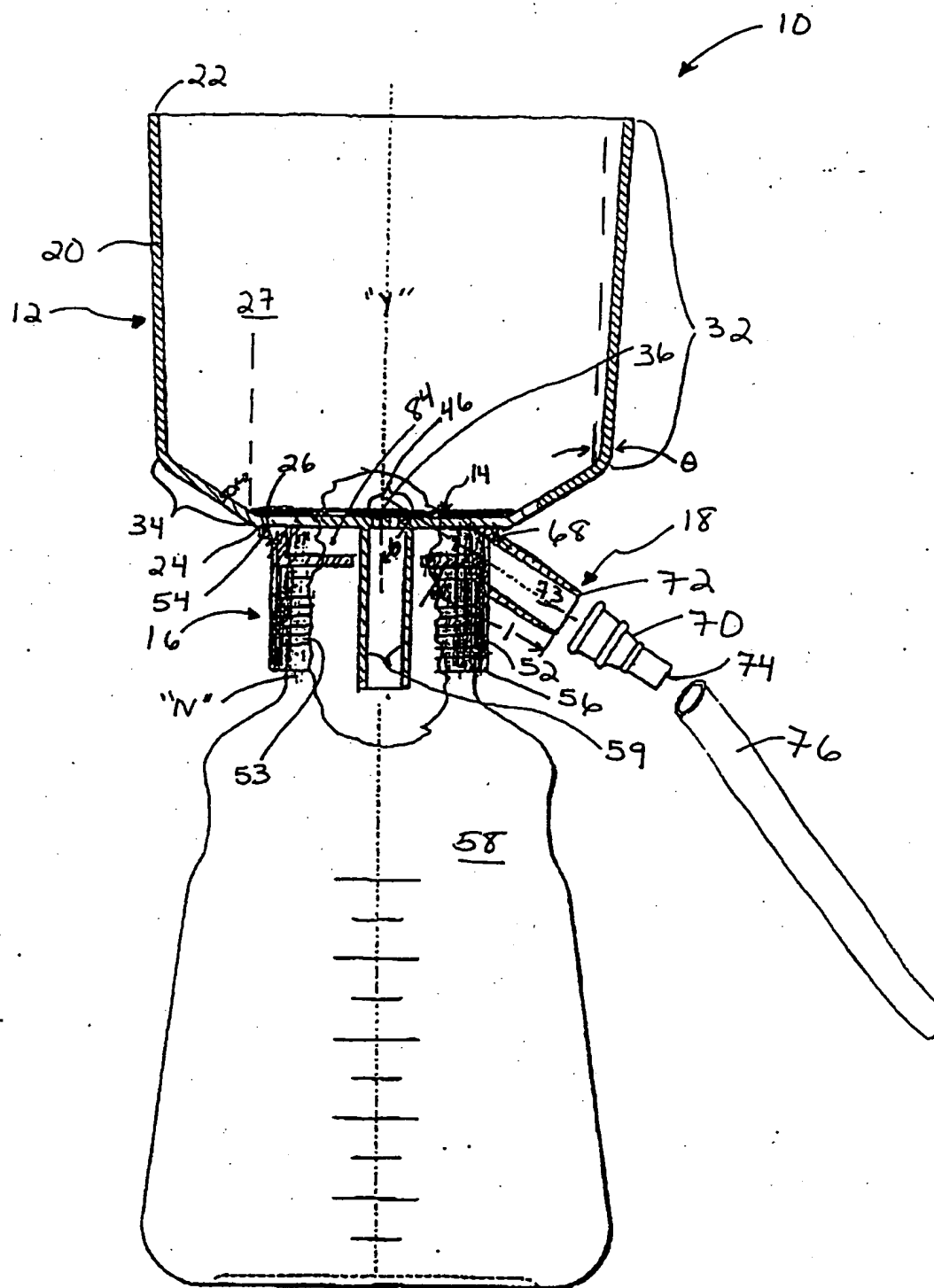


Fig. 1

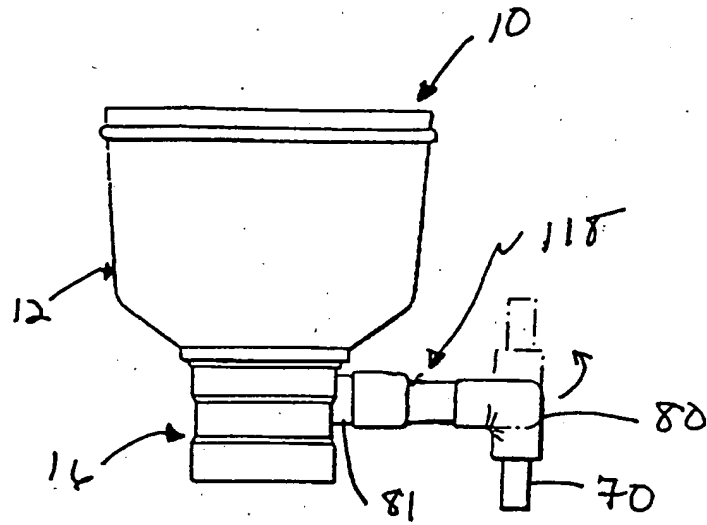


Fig. 2a

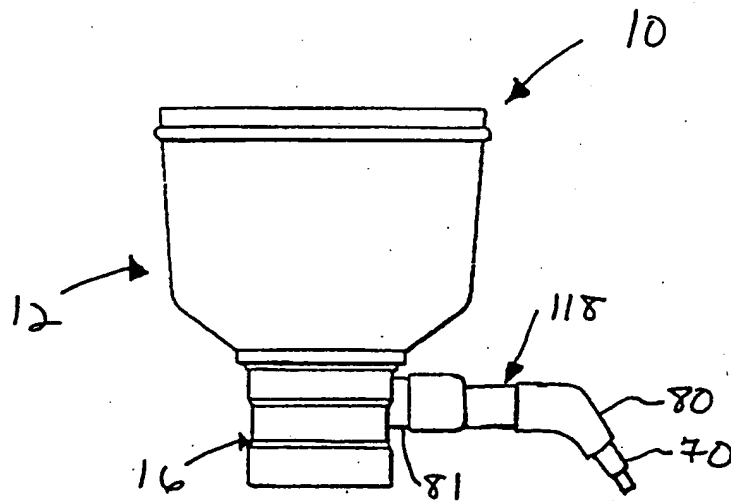


Fig. 2b

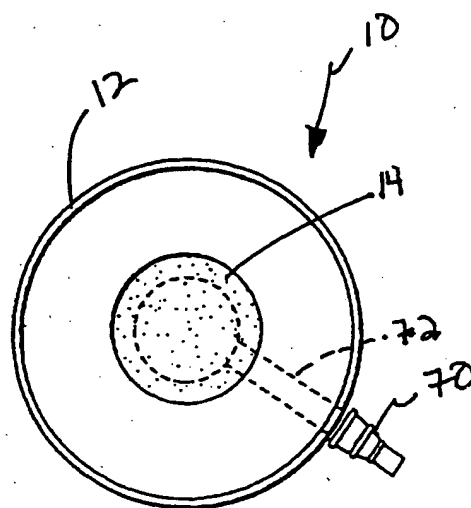
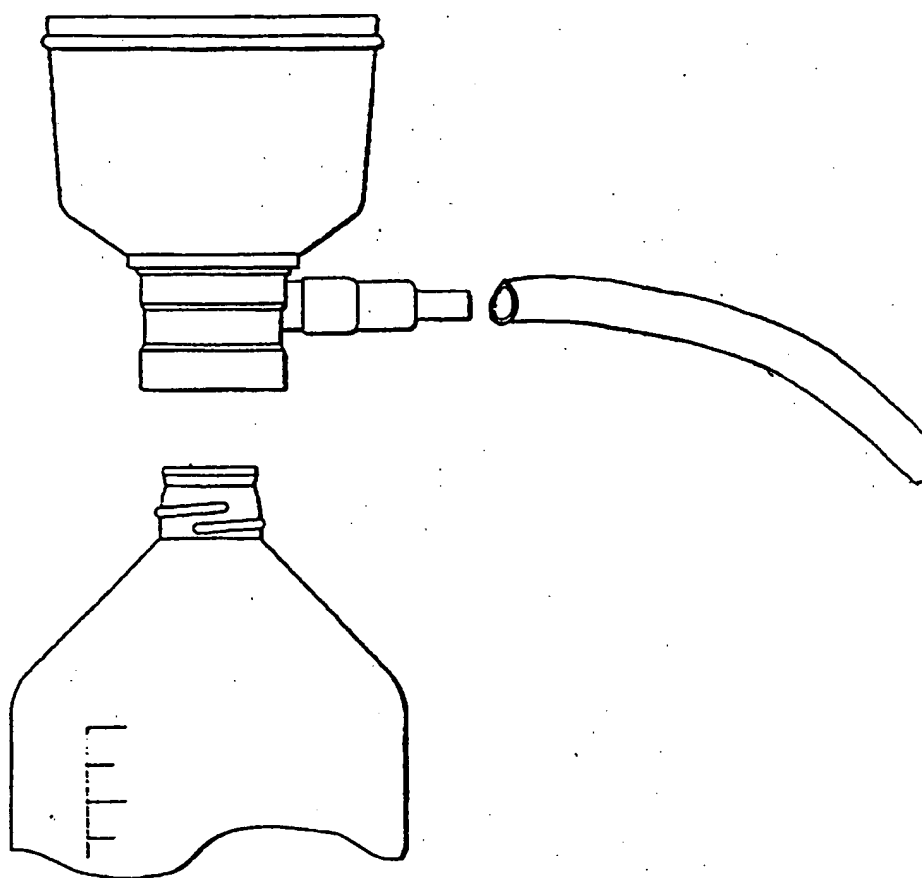


Fig. 3



**Fig. 4**  
(Prior Art)